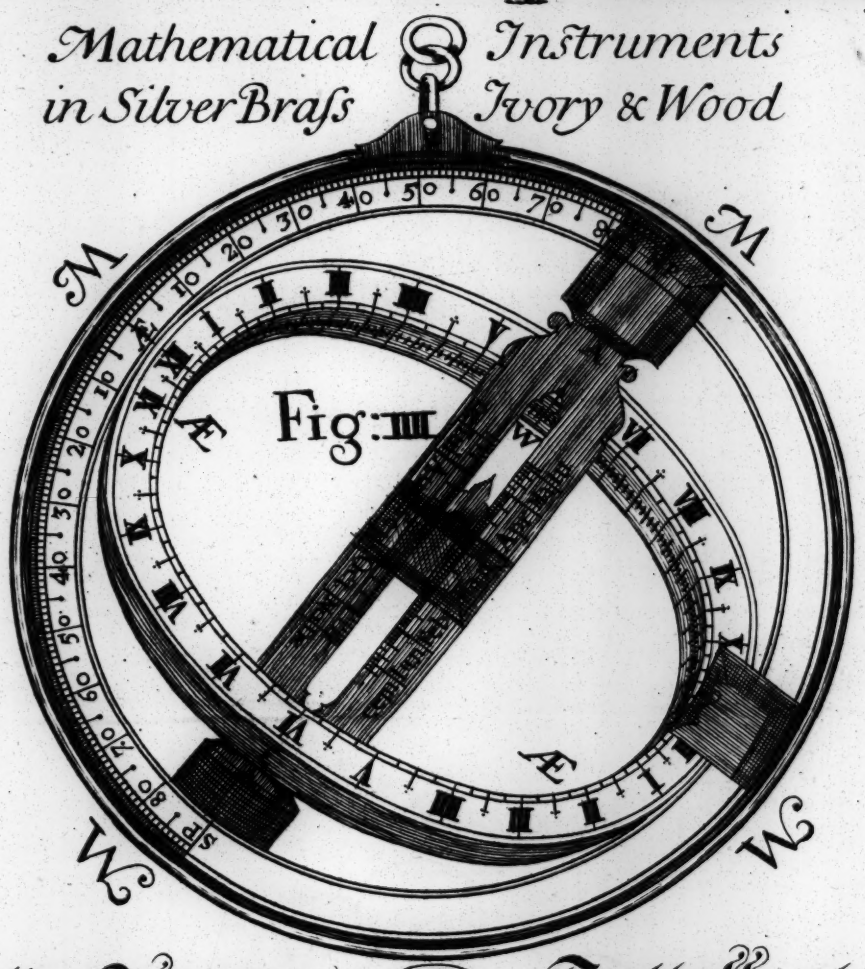
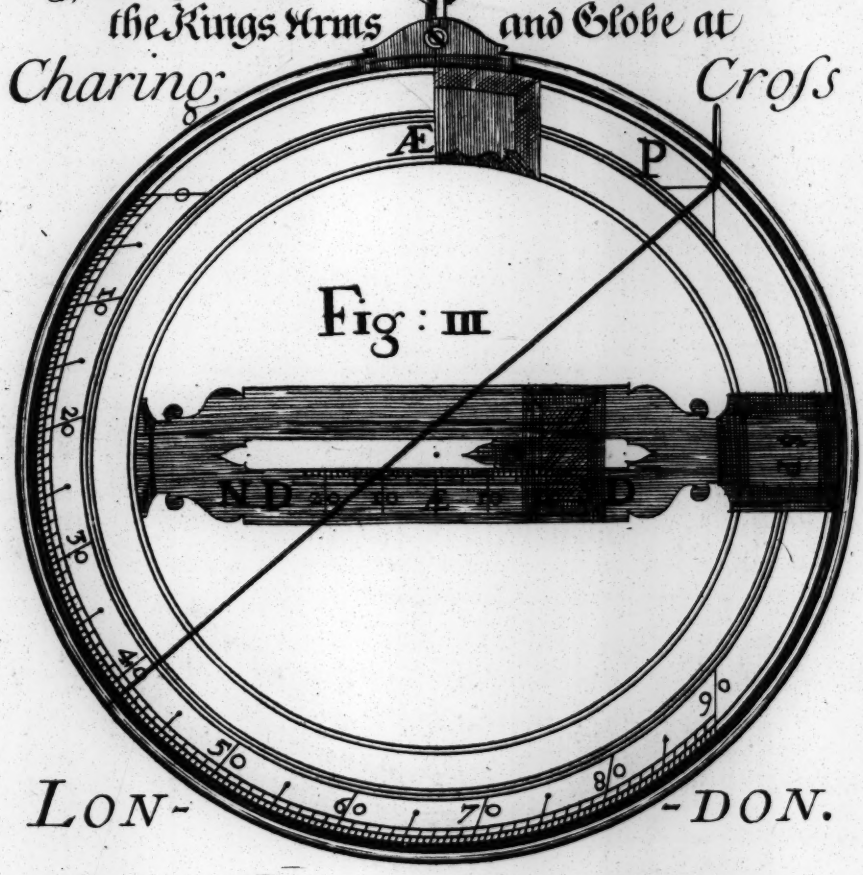
Mathematical Instruments
in Silver Brass Ivory & Wood



By Thomas Tuttell. at
the Kings Arms and Globe at
Charing *Cross*



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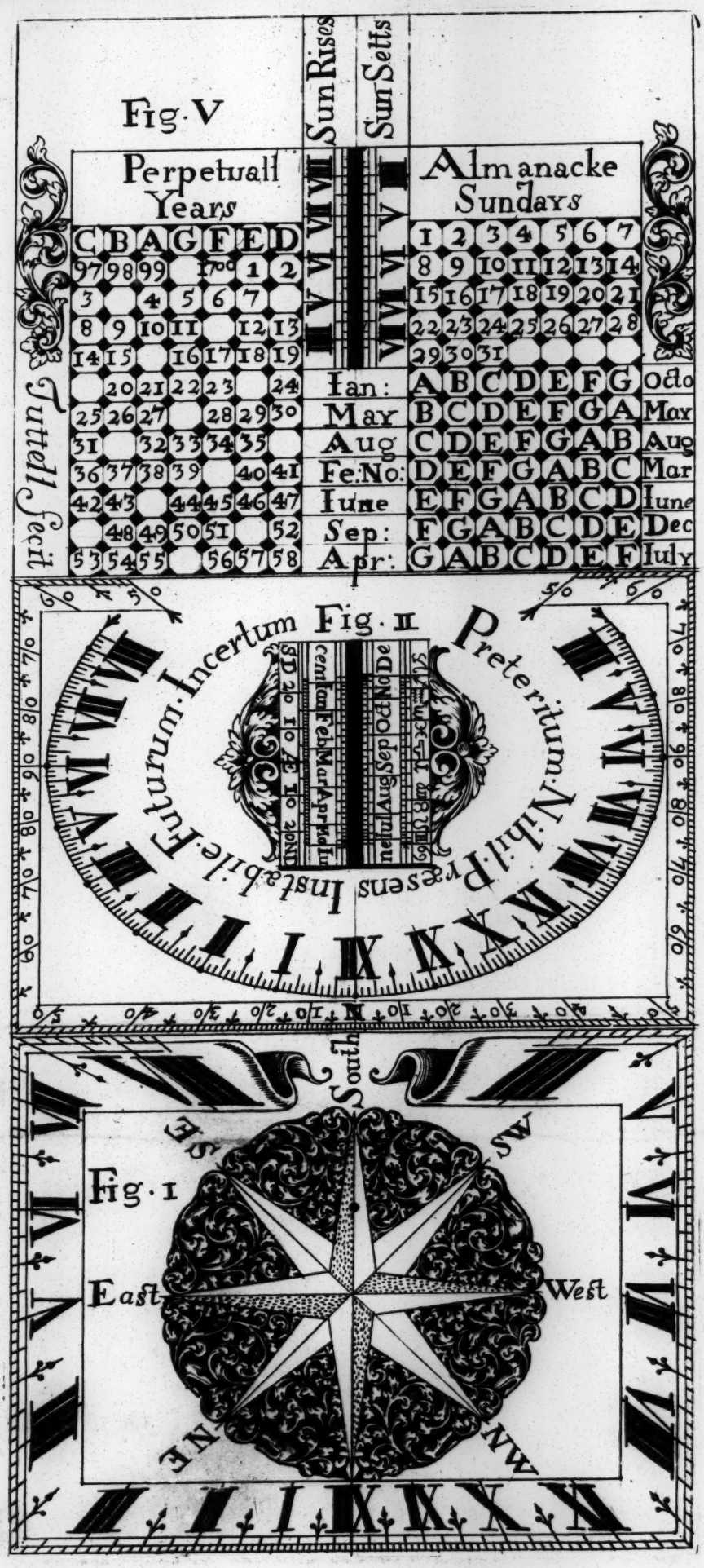
Fig. V
Sun Rises
Sun Setts
Perpetuall Years
Almanacke Sundays
C B A G F E D
1 2 3 4 5 6 7
97 98 99 1mo 1 2
8 9 10 11 12 13 14
3 4 5 6 7
15 16 17 18 19 20 21
8 9 10 11 12 13
22 23 24 25 26 27 28
14 15 16 17 18 19
29 30 31
20 21 22 23 24
Ian: A B C D E F G Octo
25 26 27 28 29 30
May B C D E F G A May
31 32 33 34 35
Aug C D E F G A B Aug
36 37 38 39 40 41
Fe: No: D E F G A B C Mar
42 43 44 45 46 47
Iune E F G A B C D Iune
48 49 50 51 52
Sep: F G A B C D E Dec
53 54 55 56 57 58
Apr: G A B C D E F July
Futtell fecit
Fig. II
Futurum. Incertum. Instabile. Presens. Preterium. Nihil.
Fig. 1
South
East
West
SE
SW
NE
NW

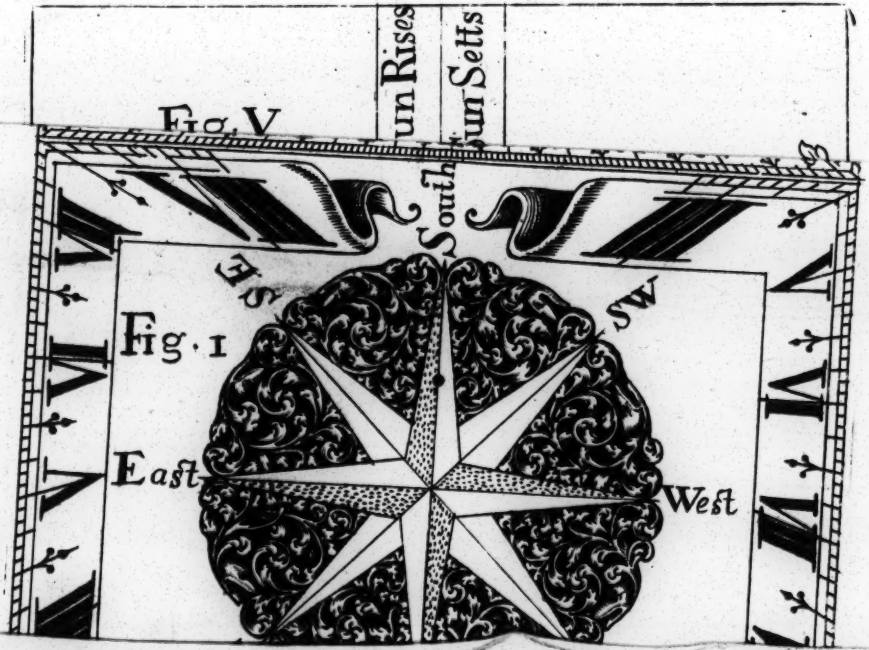
Fig. V
Sun Rises
South
Sun Setts
SE
SW
Fig. 1
East
West

THE

Deſcription and Uſes

Of a New Contriv'd

Eliptical / Double } DIAL;

As alſo of the Gunter's

Univerſal / Æquinoctial } DIAL.

Which ſerve to find the *Latitude*, *Hour* of the *Day*, the True *Meridian*, the *Altitude*, *Azimuth*, and *Declination* of the *Sun*; his *Place* in the *Ecliptick*, the *Time* of his *Riſing* and *Setting*, Length of *Day* and *Night*, *&c.* With a *Scheme* of each DIAL Curiouſly Engraven.

Very Uſeful for all Seamen and Travellers, and our Curious Gentry to Set, Examine, and Adjuſt their Pendulums.

Whereunto is added a Correct Table *of the* Latitude *of the moſt Eminent* Cities *and* Towns *in* Europe; *As alſo a* Table *of* Equation.

By *Tho. Tuttell* Mathematical Inſtrument-maker at the *Kings-Arms* and *Globe* at *Charing-Croſs.*

London, Printed by *W. Redmayne* for the Author, and are to be Sold by *J. Harris* at the *Harrow* in *Little-Brittain*, 1698. Price Stitcht One Shilling.

TO THE

Great Encourager of

ARTISTS,

The HONOURABLE

Coll. *W. P.*

Sir,

THE daily *Encouragement* I have Received from *Your* Hands, ſince I firſt had the *Honour* of being known

to *You*, makes me preſume to offer this little *Treatiſe* to *Your* Peruſal. And indeed, in Relation to the *Eliptical Dial*, I think my ſelf *Obliged* to own, that it was through *Your Improvement* of the firſt I ſhew'd you(by Applying the *Joynts*, *&c.*) that it is now brought to that *Perfection*, that I almoſt perſwade my ſelf it will generally Pleaſe. Were all the *Improvements*, we ſtand Indebted to *You* for, to be here Enumerated, it would ſwell this *Dedication* beyond the Limits Modeſty confines me to: Yet give me leave, *Sir*, to ſay this, That *England* never yet could *Boaſt* of ſuch *Mechanicks* as *You* have made, or

or of *Work* brought to ſo high a *Perfection*, as ſince *You* have been Happily concern'd in it; Thoſe who have the *Honour* to Receive *Your* Immediate *Directions*, cannot Err; and others in hopes of obtaining it, will not; Nay, they dare not (if I may ſo ſpeak) ſince at preſent the greateſt part of our *Nobility* and *Gentry* are, by Uſe, and *Your* Inſtructions, become themſelves ſuch *Judges* in what is *Curious*. This, *Sir*, is wholly owing to *YOU*, who at once Revive *Art* and the *Artiſt*. Pardon therefore this piece of *Zeal* in me, of laying hold on this *Occaſion* to

Publiſh to the *World* how happy *You* make all thoſe you are ſo kind to *Employ*; more particularly,

Sir,

Your moſt Obliged,

and Obedient Servant,

Charing-Croſs,
April 13. 1698.

Tho. Tuttell.

TO

TO THE

READER.

AMong *all the various Sorts of* Inſtruments, *for finding the* Hour, &c. *Invented and Publiſhed by the Learned* Stoflerus, Gemma-Friſcius, Tycho-Brahe, (*cum multis aliis*) *None will appear ſo* Obvious *and Eaſie for Uſe as this* Eliptical Dial; *though the* Æquinoctial Dial *has hitherto deſervedly had* Preference *of all others*; *being Compoſed of the Two Principal* Circles *of the* Sphere, viz. *The* Meridian *and* Æquinoctial

ctial *Circles*; *and inſtead of the* Zodiack, *our Learned and Reverend Divine*, *Mr.* Outhred *of* Eaton, *added an* Axis, *which rendred it much more Portable and Eaſier to* Uſe.

Now this Eliptical *may (properly enough) be called an* Æquinoctial Horizontal Dial; *becauſe it is the* Æquinoctial Dial *Orthographically Projected on the Plane of the* Horizon. *For, Rectify the* Æquinoctial Dial *as in* Fig. IV. *And conceive Infinite Perpendiculars to be let fall through every Point of the* Æquinoctial, *which will mark out the* Eliplis *on the* Horizontal *Plane*, Fig. II. *and the Hour Points of the* Æquinoctial *will be the Hour Points on the* Eliplis.

Again,

Again, Perpendiculars let fall from the Axis *of the* Æquinoctial Dial *will project the Kalendar,* &c. *On the Eliptical* Fig. II. *Each of theſe* Dials *ſet themſelves: Whereas others require the* Altitude *of the* Sun, *a* Meridian *Line, an* Horizontal *Plane, a* String *and* Plummet, *a pair of* Compaſſes, *or the like, Theſe have all in themſelves that is needfull; ſo that they are* Preferable, *for finding the* Hour, &c. *to all other* Rings, Cylinders, Quadrants, *and* Aſtrolabes *whatſoever. Alſo more* Portable *than others, Each being put in a neat* Shagrine Caſe, *fit for the Pocket, therefore the only* Dials *for* Seamen *and* Travellers: *They may be made, according to the Size and Curioſity of the Work,*

Work, from Five Shillings *a piece to Five* Pounds.

Though many Learned Mathematical Treatiſes, *in* Latin, French, *and* Engliſh, *are Extant among us, yet I find the great want of ſuch* Books *as might ſerve to* Explain *the* Uſes *of divers* Mathematical Inſtruments, *has very much* hindred *the* Knowledge *of the moſt uſeful* Part *of the* Mathematicks. *I purpoſe therefore (as opportunity will give leave) to* Publiſh *a little* Tract *that ſhall peculiarly Treat of the* Uſes *of the Principal* Inſtruments *relating to* Engineers, Builders, Gardners, Sailors, *and others*:

Though I could heartily wiſh ſome more Able Pen *would* undertake *this* Task: *In the mean time*

time it is hoped, that all Faults *and* Miſtakes *of the* Author *will be* Pardon'd, *and his* Endeavours, *in this ſo uſeful an* Eſſay, *for the* Publick good, *be* Candidly *Accepted.*

The

THE CONTENTS.

CHAP.

CHAP. I.

Of the *Eliptical* / *Double* } DIAL.

The Deſcription and Names given to its Parts.

1. IT is compoſed of Two Plates of Braſs or Silver, which folding together by the help of a joint one is called the *Horizontal Plane*, Fig. I. the other the *Eliptical*, Fig. II.

2. In the middle of the *Eliptical Plane*, Fig. II. is a Slit, in which there moves a piece of Braſs or Silver, with a ſtreight edge a-croſs, faſtened by a Steel Spring on the back-ſide, and this we call the *Eliptical* ſlider, which alſo hath a little Pin to hang a Plummet on.

3. There is a thin piece with a Joint to lie flat or ſtand upright upon the ſlider, which we call the *Perpendicular* Stile.

4. In the middle of the *Plane*, Fig. I. is a piece of Braſs or Silver, which riſes and falls by the help of a Spring, and hath a littlePlummet in it,and this we call the *Horizontal* Stile.

Laſtly, Two Screws in the *Eliptical Plane*, and one Screw or Stud in the *Horizontal Plane*,ſerving to ſet it level.

CHAP. II.

Of the *Eliptical* / *Double* } DIAL.

The Graduations or Diviſions on each Part.

1. THE *Elipſis* is divided into ev'ry fifth Minute, and hath *Capital Figures* ſet to each hour, as in the Scheme, Fig. II.

2. About

2. About the *Eliptical Dial* in a Square are graduated the Degrees of a Circle, and figured both ways from *N* by 10. 20. and ſo to 90.

3. The two Inner Lines on each ſide the ſlit Fig. II. contain the Kalendar according to the old or new Stile, and is divided into Months and Days, with the Names of each Month. Theſe Months, on the ſmalleſt *Dials*, are divided only into every fifth day, the intermediate days being Eſtimated; others have ev ry ſecond day, and large *Dials* may have every day, but in all of them near the *Tropicks* or *Solſtices*, *viz.* about the 11th. of *June*, and 11th. of *December* have every fifth, or every tenth day only.

☞ Thoſe who Live in *Germany*, *France*, *Italy*, &c. where they uſe the new Stile (or *Gregorian* Account) may have it put on, or Travellers may uſe theſe Months there, accounting Ten days forward.

Thus the { 1 *Jan.* / 25 *Mar.* / 24 *June* / 29 *Sept.* / 25 *Dec.* } In the old Stile is the { 11 *Jan.* / 4 *Apr.* / 4 *July* / 9 *Oct.* / 4 *Jan.* } in the new.

Or they may have the new Stile on one ſide, and the old on the other.

4. Adjoyning to one ſide of the Months is a Line, which is Charactered with the 12 Signs of the *Zodiack* to ſhew the Sun's place, Fig. II.

5. Adjoyning to the other ſide of the Months, is a Line divided into twice $23\frac{1}{2}$ degrees, and number'd from *Æ.* both ways, by 10, 20. to *N. D.* North Declination, and *S. D.* South Declination.

6. On the back ſide of the *Eliptical Plane* are two Lines, to ſhew the Riſing and Setting of the Sun by the edge of the ſliding Spring, Fig. V. alſo a perpetual *Almanack* after the moſt plain and eaſie method, as in the *Scheme*, Fig. V. whereas others require the *Dominical Letter*, firſt of *March*, a Key day, or ſomewhat that is Burdenſome to the memory; this finds

finds all by knowing only the Year of our Lord.

7. On the Outward Square Margine Fig. I. are Projected every fifth Minute of Time with Capital Figures at each hour, and this is called the *Horizontal Dial.*

Laſtly, From the Centre of the *Plane* are Projected the Points of the World, or *Seaman's* Compaſs, to ſhew readily the Situation of any place.

CHAP. III.

Of the *Univerſal* / *Æquinoctial* } DIAL.

The Deſcription and names given to its Parts.

1. IT is compoſed of Two Rings of Braſs or Silver, which ſhut one within another, as Fig. III. the greateſt of which marked *M M M M* Fig. IV. is called the *Meridian*; the other noted *Æ Æ E W* is called the *Æquinoctial.*

2. To the *Meridian* at the Letter *Z* is a Slider with 2 Rings to hang or hold the Inſtrument; this is called the Curſor of the *Meridian* or *Zenith*, Fig. IV.

3. The Piece a-croſs the *Meridian* is named the *Diameter Bridge* or *Axis*, and this is made to turn upon Pevits at *A A*, Fig. IV.

4. Along the Middle of the *Axis* is a Slit, in which there moves a Slider, having a ſmall hole through it, at *G* and this is called the Curſor of the *Axis*, Fig. IV.

Laſtly, The 4 Pieces ſticking up 2 upon one ſide at *N P*, and *Æ*, Fig. IV. and 2 on the other ſide at *S P* and *Æ*, Fig. III. are called Studs, of theſe 2 ſerve to hold the *Axis*, the other to ſtay the *Æquinoctial* in its proper place, when turn'd out for finding the Hour, Fig. IV.

CHAP.

CHAP. IV.

Of the *Univerſal* / *Æquinoctial* } DIAL.

The Graduations or Diviſions on each Part.

1. THE *Zenith* hath one ſtroke at *Z*, Fig. IV.

2. One half of the *Meridian* is divided into 2 *Quadrants*, and each *Quadrant* into 90 Equal Parts called degrees of *Latitude*; ſome *Dials* have each degree ſubdivided (as in the *Scheme*) Fig. IV. Larger may have Quarters, and theſe degrees are figured from *Æ* the *Æquinoctial* by 10. 20. 30, *&c.* both ways up to *N P* and *S P* the *North* and *South Poles*.

3. The *Æquinoctial* is divided upon the Flat, and in the middle line, into twice 12 Equal Parts, (Hours) and each Hour according to the bigneſs of the *Dial*.

Into { 12, 15, 20, 30, 60 } *which is every* { 5, 4, 3, 2, ... } *Minute.*

4. The *Axis* contains the *Kalendar*, and hath the Months graduated thereon. Fig. IV.

☞ Thoſe who deſire it may have the Lines added as on the *Eliptical Dial.* See the *5th.* and *6th.* of Chap. II.

5. The Curſor hath a little hole through it, and a Line a-croſs at *G.* Fig. IV. which is to be ſet to the day of the Month.

6. This ſide of the *Meridian* Fig. III. has 90 Degrees graduated thereon, numbred by 10, 20, &c. And this is call'd the *Quadrant* of *Altitude*; its uſe being to give the heighth of the Sun, by a Pin ſtuck upright in P.

Laſtly, This ſide of the *Axis* Fig. III. hath a Line to ſhew the Sun's Declination, numbred from *Æ* both ways by 10, 20. to *N. D.* and *S. D.* here alſo the Curſor hath a Line a-croſs at *G.*

Chap.

CHAP. V.

Of *Aſtronomical Terms.*

In this Chapter ſome Aſtronomical Terms *ſhall be explained, which being underſtood, the Reaſon of theſe* Dials *will appear, and conſequently, their uſes may be more Familiar.*

1. *Aſtronomers* ſuppoſe every Circle to be divided into 360 Equal Parts, which they call Degrees; and every Degree to be Sub-divided into 60 Equal Parts called Minutes; every Minute into 60 Seconds, and ſo on.

Now the Reaſon why they chooſe 360 before any other Number is, becauſe it has the moſt *Aliquot* Parts or Numbers, which will meaſure it Equally, *viz.* 2. 3. 4. 5. 6. 8. 9. 10. 12. 15. 18. 20. 24. 30. 36. 40. 45. 60. 72. 90. 120. 180. will all of them divide it without any remainder. The Half, or Semicircle contains 180. The *Quadrant* or

or 4*th* Part 90. &c. Now the *Æquinoctial* Circle being divided into 24. is in proportion of Degrees to Hours, as 15. to 1. And becauſe as well Hours as Degrees are divided, each of them, into 60 Minutes, therefore the Minutes of a Degree to the Minutes of Time are alſo in proportion, as 15. to 1. that is, 15. Degrees make one Hour, and 15. Minutes of a Degree make one Minute of Time.

2. The *Poles* of the World, or *Poles* of the *Equinoctial* are 2 fixed Points in the Heavens, Diametrically oppoſite to one another; One of them called the *Artick* or *North*-*Pole*, is viſible in our *Hemiſphere*, but the other called the *Antartick*, or *South*-*Pole*, lies hid.

3. The *Axis* of the World is an Imaginary right Line, paſſing from one *Pole* through the Center of the Earth to the other; about which the whole World turns from *Eaſt* to *Weſt* in the ſpace of 24 Hours.

4. The *Horizon* is a great Circle, dividing the Heavens into 2 equal Parts,

Parts, *viz.* the upper and viſible *Hemiſphere*, and the lower and inviſible; In this Circle, the Sun, Moon and Stars Riſe and Set. *Navigators*, or *Seamen* divide the *Horizon* in 32 equal Parts, which they call the Winds or Points of the Compaſs. Note, every Place hath its peculiar *Horizon*.

5. The *Poles* of the *Horizon* are the *Zenith*, or Point in the Heavens, directly over our Heads, and the *Nadir*, or Point, directly under our Feet.

6. The *Meridian* is a great Circle in the Heavens, paſſing through the *Poles* of the World, and *Poles* of the *Horizon*; it croſſeth the *Horizon* at right Angles, and divides the World into the *Eaſtern* and *Weſtern Hemiſpheres*. To this Circle, when the Sun cometh, which is twice in 24 Hours, it maketh Noon (or Mid-day) and Midnight. All Places that lie, *Eaſt* or *weſt* of one another, have their ſeveral *Meridians* and all that lie, *North* or *South*, have the ſame *Meridian*.

Laſtly; The *Equator* or *Equinoctial*, is a great Circle, every way 90 Degrees

grees distant from the *Poles* of the World; it cuts every *Meridian* at right Angles, and divides the World into the *Northern* and *Southern Hemispheres*, when the Sun cometh to this Circle, which is twice a Year, *viz.* when he enters; ♈ *Aries* and ♎ *Libra*, the Day and Night are equal all the World over.

CHAP. VI.

Of *Astronomical Terms.*

1. THE *Ecliptick* is a great Circle, crossing the *Equinoctial*, obliquely making therewith an Angle of $23\frac{1}{2}$ Degrees; in this Circle, the Sun always keeps his Course; it is divided into 12 Inns, called Signs; through which the Sun having passed, is said to have performed his Annual Motion.

The

The 12 Signs are

Aries	♈	Called *Northern* Signs.	*Libra*	♎	called *Southern* Signs.
Taurus	♉		*Scorpio*	♏	
Gemini	♊		*Sagitarius*	♐	
Cancer	♋		*Capricorn*	♑	
Leo	♌		*Aquarius*	♒	
Virgo	♍		*Piſces*	♓	

And theſe Signs make that broad *Zone* or *Girdle* in the Heavens, called the *Zodiack:* In theſe *Dyals*, the *Ecliptick* is projected on the *Eliptical Plane*, and on the *Axis* of the *Equinoctial.*

2. The *Coluri* are 2 *Meridians* at right Angles to each other; one of which cuts the *Equinoctial* and *Ecliptick* in the Points of ♈ *Aries* and ♎ *Libra*, and is called the *Equinoctial Colure*; the other cuts the *Ecliptick* in the Points of ♋ *Cancer* and ♑ *Capricorn*, and is called the *Solſticial Colure.*

3. Parallel to the *Equinoctial*, at the diſtance of 23½ Degrees, on either ſide are 2 leſſer Circles, called *Tropicks*, deſcribed by the Sun when he enters ♋ and ♑, that of ♋ is called the *Northern Tropick*, or *Summer Solſtice*, the other the *Southern*, or *Winter Solſtice.*

4. Al-

4. Alſo Parallel to the *Equinoctial* on either ſide, at the diſtance $23\frac{1}{2}$ Degrees from each *Pole*, are 2 other leſſer Circles; that next the *North Pole* is called the *Artick* Circle, the other the *Antartick*——Theſe Circles are deſcribed by the *Poles* of the *Ecliptick*.

☞ Theſe 4 leſſer Circles divide the World into 5 *Zones* or *Girdles*; the *Torrid Zone* is that Space between the *Tropicks*, the 2 *Temperate Zones* are bounded by the *Tropicks* and the Polar Circles; the two *Frigid Zones* are contained within the Polar Circles.

5. *Azimuths* are great Circles meeting in the *Zenith* and *Nadir*; they croſs the *Horizon* at right Angles, *viz.* They have ſuch Habitude to the *Horizon*, *Zenith* and *Nadir*, as the *Meridian* hath to the *Equator* and its *Poles*; that *Azimuth* which paſſeth through the *Eaſt* and *Weſt* Points, is called the Prime *Vertical*.

6. *Almicanthars*, or Parallels of Altitude are leſſer Circles, Parallel to the

7. Pa-

Horizon, diminiſhing while they end in a Point, *viz.* the *Zenith*.

7. Parallels of *Latitude* are leſſer Circles on the Earth; they are Parallel to the *Equator*, diminiſhing while they terminate in a Point at the *Poles*. In the Heavens they areParallel to the *Ecliptick*, and end in a Point at its *Poles*.

Laſtly, Parallels of Declination in the Heavens, are the ſame with Parallels of *Latitude* on Earth, *viz.* they are Parallel to the *Equinoctial*, and terminate in the Poles of the World.

CHAP.

CHAP. VII.

USES

Of the *Eliptical* / *Double* } DIAL.

And firſt of the Perpetual Almanack.

THere are very many *Almanacks* of this kind Extant; but I know none more fit for the Inſtrument than this in the *Scheme*. Fig. V. It is contriv'd as eaſie as may be, and thoſe who deſire it may have any other Graduated in its place.

PROB. I.

Knowing the Year of our Lord,
To find the Day of the Month.

1. Look for the Year under the Word Years, and the Top of the ſame Column ſhews the *Dominical Letter.*

2. Look againſt the Month you require for the ſame Letter, over which (in the ſame Column) are the Sundays in that Month. Exam-

EXAMPLE I.

Let it be required to find what Day of the Month is the firſt Monday in *Decemb.* 1697.

Find 97. among the Years, Fig. V. over which you'll find *C.* Then among the Months find *December* and againſt it *C.* over which (in the ſame Column) you'll find all the Sundays in *Dec. viz.* 5. 12. 19. 26. Now the 5*th.* being the firſt Sunday, count on one Column and you have Monday the *6th.*

EXAMPLE II.

What Day of the Month is the firſt Monday in *Dec.* 1720.

Firſt find the Year, over which you'll find *B.* then againſt *Dec.* over *B.* you find the firſt Sunday to be the 4*th.* and conſequently, Monday the 5*th.*

EXAMPLE III.

What Day of the Month is the third Friday in *January*, 1698.

Over 1698. you'll find *B.* and againſt *Jan.* over *B.* the firſt Sunday to be the 2*d.* the ſecond Sunday the *9th.* the third Sunday the *16th.* then count on in the Squares, as the Figs. run thus. Monday 17. Tueſday 18. Wedneſday 19. Thurſday 20. and Friday 21.

EXAMPLES.

	1	Friday		*Mar.* 1699	Will be	3*d.*
Alſo	3	Wedn.	In	*Jan.* 1700	found	17*th*
the	1	Thurſ.		*May* 1701	to be	1*ſt.*
	2	Sund.		*Dec.* 1710	the	10*th*

PROB. II.

Knowing the Year of our Lord, to find what Day of the Week is any Day of the Month. Examples.

This is the Reverſe of the former (but as uſeful.)

What Day of the Week is the 5*th.* of *January* 1698. Over 98. you'll find *B.* and againſt *January* over *B.* you'll find the 2*d.* to be Sunday, the 3*d.* Monday, the 4*th.* Tueſday, and the 5*th.* to be Wedneſday. Alſo

The

The	25	of	*March* 1698	Will be found to be	Frid.	
	1		*June* 1736		Tueſ.	L. year
	3		*Dec.* 1740		Wed.	L. year
	30		*April* 1750		Mon.	

☞ Each blank ſpace ſhews the Year following to be Leap-Year, at which time uſe the Letter over blank for *Jan.* and *Feb.* And Note alſo, the Year begins from the firſt of *Jan.*

PROB. III.

Any Day of the Month given to find the Sun's Declination.

1. Move the *Eliptical* Slider to the Day of the Month, and the Edge will cut the Sun's Declination (in the Line of Declination.)

☞ The Declination of the Sun is his diſtance from the *Æquinoctial* any Day at Noon.

EXAMPLE I.

Let it be required to find the Sun's Declination on the 12*th.* of *Sept.*

Moving the Slider to the Day, it cuts *Æ.* in the Line of Declination, which ſhews that the Sun on that Day hath no Declination, but moves in the *Æquinoctial.*

EXAMPLE II.

May 11. the Sun's Declination will be found to be 20 D. 20 M. *North-*ward of the *Æquinoctial.*

EXAMPLE III.

October 20. the Sun's Declination will be found to be 14 D. 00 M. *South ward* of the *Æquinoctial.*

PROB. IV.

The Sun's Declination being given to find the Day of the Month.

Move

Move the Slider to the Declination, and the Edge cuts the Day of the Month.

EXAMPLE.

The Sun's Declination being 8 Degrees *South*, move the Edge of the Slider towards *S. D.* to 8 Degrees, and it will cut the *17th.* of *Feb.* and the *3d.* of *October*, on either of which Days the Sun hath 8 Degrees of Declination.

PROB. V.

The Day of the Month given, to find the Sun's Place in the Ecliptick.

Move the Slider to the Day, and it cuts the Sun's Place. Fig. II.

EXAMPLES.

September 12. Set the Slider to the Day, and it will cut the beginning of *Libra*, which ſhews that the Sun enters ♎ on that day.

So ſhall you find D. M.

The { 11 / 20 / 1 } of { *May* / *Oct.* / *Sep.* } the Sun will be { 00 30 / 07 15 / 18 45 } of { ♊ / ♍ }

PROB. VI.

The Sun's Place being given to find the Day of the Month.

The Sun being in 10 D. of ♈ *Aries* the Slider ſet thereto will cut the 20*th.* of *March.* Fig. II.

PROB. VII.

The Day of the Month given to find the time of his Riſing and Setting.

September 12. move the Slider to the day, and the Steel-ſpring on the back-ſide cuts VI. and VI. which ſhews the Sun Riſes and Sets that day at VI.

May the 11*th.* The Slider cuts about VIII. and IV. the Sun's Riſing and Setting that day. Fig. V.

PROB.

PROB. VIII.

Any Day of the Year, given to find what other Day of the Year is of the ſame length therewith. Fig. II.

Sept. 12. move the Slider to the Day, and the oppoſite Day, *viz.* the 10th of *March* will be equal to it, alſo will be found. Fig. II.

the { 1 / 12 / 1 } of { *Mar.* / *Aug.* / *May.* } equal to the { 21 / 10 / 23 } of { *Sept.* / *April.* / *July.* }

Now theſe Days are ſaid to be equal each to the other in theſe Reſpects.

1. Of the Sun's Declination, it being the ſame on both.

2. Of the Sun's *Altitude* and *Azimuth.* For what *Altitude* and *Azimuth* the Sun has on any hour upon one, the ſame will be his *Altitude* and *Azimuth*, on the ſame hour upon the other.

3. The time of his Riſing and Setting, is the ſame on both.

Laſtly, They are equal in length, both Day and Night.

PROB. IX.

The Riſing and Setting of the Sun, being given, to find the length of Day and Night.

1. Find the Sun's Riſing and Setting by the 7. *Prob.* of this Chapter, Fig. V.

2. Double the time of his Riſing, and it gives the length of the Night.

3. Double his Setting, and it gives the length of the Day.

EXAMPLE I.

September 12. The Sun Riſes at VI. which double gives 12 Hours for the length of the Night; and the Sun Sets at VI. which doubled, gives 12 Hours alſo for the length of the Day; which ſhew the Day and Night on that Day to be equal.

EX-

EXAMPLE II.

May the 11th, the Sun Riſes at 4. which doubled, give 8 Hours for the length of the Night, and Sets at 8; which Doubled gives 16 Hours for the length of the Day.

☞ The length of the Day and Night, added together, makes one Natural Day or 24 Hours.

PROB. X.

The Day of the Month (or Place of the Sun in the Ecliptick, *or Declination, or his Riſing or Setting) given to find all the reſt.*

EXAMPLE. I.

June 11th. Set the Slider to the Day, and the Sun's Place will be found entring ♋ *Cancer*, his Declination $23\frac{1}{2}$ Degrees *North*; that he Riſes 47 Minutes after 3, and Sets 13 m. after 8; that the length of the Night is 7 Hours

7 Hours 34 m. and the length of the Day, 16 Hours 26. m.

☞ The Sun being in the Solſtice, the Days for about a Week ſeem to be equal.

EXAMPLE II.

December the 11th. Move the Slider to the Day, and the Sun's Place will be entring ♑ *Capricorn*, his Declination $23\frac{1}{2}$ Degrees *South*; his Riſing 13 m. after 8, and his Setting 47 m. after 3, the length of the Night, 16 Hours 26 m. the length of the Day, 7 Hours 34 m. here alſo for about a Week, the Days ſeem to be equal to one another.

EXAMPLE III.

March 10th. Move the Slider to the Day, and it ſhews the Sun enter ♈ *Aries*, the Declination to be O. The Sun Riſes at 6, and Sets at 6; the length of Day and Night being 12 Hours, and the Day equal to it is the 12th of *September*.

CHAP.

CHAP. VIII.

USES

Of the *Eliptical* / *Double* DIAL.

PROB. I.

To find the Sun's Altitude.

☞ The *Altitude*, or height of the Sun, is an Arch of an *Azimuth*, contain'd between the Center of the Sun and the *Horizon*; the *Meridian Altitude* is his height any Day at Noon.

Some time before Noon, move the Slider; ſo that the little Pin may juſt ſtand at Æ in the Line of Declination; then hang on a Thread and Plummet, and raiſe the Perpendicular Stile; then hold it in your Hand, that the Thread may play freely on the *Eliptical Plane*, and move it gently up and down, till the Shadow of the

the Stile cut the Meridian, or 12 a Clock Line; then make 2 or 3 Obſervations; and the greateſt Degree the Thread cuts, is the *Meridian Altitude* for that Day.

EXAMPLE I.

Sept. 12. Rectifie the Dial, as aforeſaid, and the Thread will fall on 38 d. 28 m. which is the *Meridian Altitude* at *London* for that Day.

EXAMPLE II.

May 11th. The *Meridian Altitude* at *London*, will be found to be 58 d. 48 m.

EXAMPLE III.

Oct. 20th. The *Meridian Altitude* at *London*, will be 24 d. 28 m.

There are 2 Days, on which the Sun's *Meridian Altitude* is the ſame; which is Explained in the 8th Prob. of the laſt Chapter.

PROB.

PROB. II.

The Sun's Meridian Altitude *and Declination given, to find the* Latitude.

☞ The *Latitude* of a Place is the diſtance of its *Zenith* from the *Æquinoctial* meaſured on the *Meridian*, either to the *North* or *South*, and is equal to the Elevation of the *Pole* above the *Horizon*.

☞ Alſo the *Colatitude* of a Place is the remainder of the *Latitude* to 90 D. or it is the diſtance between the *Æquinoctial* and the *Horizon*, and is equal to the Coelevation, which is the diſtance of the *Zenith* from the *Pole*.

Find the Declination of the Sun by the 3*d*. Prob. of the laſt Chap. and the *Meridian Altitude* by the laſt Prob. then if it be in the *Northern Hemiſphere*, and it be the *Winter* Seaſon (*South* Declination) *viz*. between the 12*th*. of *September* and the 10*th*. of *March*, add the Declination to the *Meridian Altitude*, and the ſumme is the *Colatitude*. But in

in *Summer* Seaſon (*North* Declination) *viz.* between the 10*th.* of *March* and the 12*th.* of *September*, Subſtract the Declination from the *Meridian Altitude*, and the remainder is the *Colatitude*, which taken from 90 Degrees gives the *Latitude*.

EXAMPLE I.

Sept. 12. The Sun is in the *Equinoctial*, and conſequently has no Declination; therefore his *Meridian Altitude* at *London* 38 D. 28 M. is the *Colatitude*.

EXAMPLE II.

May 11. The Sun's Declination is 20 D. 20 M. *North*, his *Meridian Altitude* at *London* 58 D. 48 M. which Declination taken from the *Altitude* leaves 38 D. 28 M. which ſumme taken out of 90 D. leaves 51 D. 32 M. the *Latitude*.

EX-

EXAMPLE III.

October 20. The Sun's Declination is 14 d. 00 *South*, his *Meridian Altitude* at *London* 24 d. 28 m. theſe added together make 38 d. 28 m. the *Colatitude*.

☞ In the *Southern Hemiſphere* when the Declination is *North*, add it to the *Meridian Altitude*, when *South* Subſtract it, and the ſumme or difference will be the *Colatitude*.

PROB. III.

The Day of the Month, and Latitude *of the Place given, to find the Hour of the Day, and conſequently the true* Meridian.

1. Move the Slider to the Day of the Month.

2. Raiſe both the *Perpendicular* and *Horizontal* Stile.

3. Elevate or Depreſs both *Dials* by the help of the Screws till the Plummet

met point againſt the *Latitude* in the *Horizontal* Stile.

4. Turn them gently about till it ſhews the ſame Hour on both *Dials*, and that is the true Time of the Day.

Alſo the Twelve-a-Clock Line is the true *Meridian*; and a Line drawn by the edge of the Inſtrument will be a ready Guide to place it at any time; ſeveral ſuch Lines may be drawn up and down in the Windows of the Houſe, and other Places where the Sun cometh.

PROB. IV.

To find the difference between the true Meridian *and* Magnetical Meridian, *viz.*

The Variation of the Compaſs.

Set the *Dial* in the *Meridian* (by the laſt) then apply a Needle in a ſquare Box to the end of the *Dial*; ſo that the *North* end of the Needle points towards the Hour of 12. then will the Needle ſhew the *Magnetical Meridian*, and the *Dial* the Sun's *Meridian*; and the Degrees cut by the Needle is the Vari-

Variation of the Compaſs, whether *Eaſt* or *Weſt*.

PROB. V.

To find the Sun's Azimuth.

Move the Slider to *Æ.* and raiſe the Perpendicular Stile; then place the *Dial* in the *Meridian* by Prob. III. of this Chap. and the Shadow of the Stile on the Deg. gives the Sun's *Azimuth* from the *North* or *South*.

☞ Here Note, as the *Dials* are for a particular *Latitude*, ſo is the Riſing and Setting of the Sun; and as in finding the Hour, they muſt be ſet *Horizontal* firſt, by continuing them ſo, they are more accepted by many than the *Æquinoctial Dial*; becauſe of the trouble of new Obſervations every time you would know the Hour by the *Æquinoctial Dial*, though 'tis much better for Travellers.

The Declination of a Plane, with many other uſeful Prob. are readily

anſwered by both *Dials*. But at preſent I ſhall not Launch farther, which would exceed my intended Limits, but proceed

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CHAP. IX.

Uſes of the *Univerſal Æquinoctial* DIAL.

What has hitherto been offered in Reſpect of the Uſes of the Eliptical Dial, *may, in a great Meaſure, be applyed to this; however, according to the Deſcription and* Scheme, *we ſhall inſtance in ſome particular Examples.*

I Will not take much time here to ſhew its Antiquity, *viz.* That it ſtands upon Record even with *Ptolomy*; nor its Improvements, which I have already ſpoken off; but ſhall only add, that the Learned *Gemma Friſcius*, in a Treatiſe Publiſhed at *Antwerp*, hath theſe

theſe Words; *Annulum ita auximus ut jam cum quovis Inſtrumento certet Mathematico*, and proceed to the Uſes.

PROB. I.

Knowing the Day of the Month, to find the Sun's Declination.

Slide the Curſor to the day of the Month, and the Line a croſs cuts the Declination.

EXAMPLE I.

Nov. 5. Slide the Curſor to the day, and the Line cuts 18 d. 44 m. Fig. IV. next *S D South* Declination Fig. III.

EXAMPLE II.

March 17. The Declination will be found 2 d. 53 m. *North.*

PROB. II.

To find the Meridian Altitude *of the Sun.*

1. A little before Noon, Slide the Curſor of the *Meridian* to the beginning of the Deg. in Fig. IV. 2. Stick a Pin upright in *P.* Fig. III. 3. Hold the Inſtrument by the little Ring, ſo that the Shadow of the Pin may fall among the Deg. in the *Quadrant* of *Altitudes*. *Laſtly*, The greateſt Obſervation is the Sun's *Meridian Altitude*.

EXAMPLE I.

Nov. 5. The Sun's *Meridian Altitude* at *London* will be found 19d. 44m.

EXAMPLE II.

March 17. The *Meridian Altitude* at *London* will be 41 d. 21 m.

PROB. III.

The Sun's Declination and Meridian Latitude, *given to find the* Altitude.

1. Get the Sun's Declination by Prob. I. and his *Meridian Altitude* by the laſt Prob.

2. If you are in *North Latitude*, and the Sun's Declination *North*, Subſtract the Declination from the *Meridian Altitude*, and the remainder is the *Co-latitude*.

3. If

3. If *South* Declination, then add them together, and the ſumm is the *Colatitude*, which taken from 90. leaves the *Latitude*.

EXAMPLE I.

Nov. 5. The Sun's Declination will be found 18 d. 44 m. *South* his *Mer. Alt.* at *London* 19 d. 44 m. which added together makes 38 d. 28 m. the *Colatitude* which Subſtract from 90 d. and it leaves 51 d. 32 m. the *Latitude*.

EXAMPLE II.

March the 17th, the Sun's Declination is 2 d. 58 m. *North*, his *Meridian Altitude* at *London*, 41 d. 21 m. Now Subſtract 2 degrees 58 minutes, from 41 d. 21 m. there remains 38 d. 28 m. the *Colatitude*, which taken from 90, leaves 51 d. 32 m. the *Latitude*.

At the next Chapter, I have Incerted a Table of the *Latitudes* of the moſt principal Places in *Europe*; ſo that it being at, or near any of them, you may make uſe of that *Latitude*; a few Miles in this Caſe makes an inſenſible Alteration. For by an Experiment,

made by our Ingenious and Painful, Country-man Mr. *Norwood*, there goes 69, or 70 Miles *Engliſh* to a Degree; wherefore if you Travel 70 Miles due *N.* or *S.* from any Place whoſe *Latitude* is already known; you muſt elevate or depreſs the Pole one Degree. But Travelling *Eaſt* or *Weſt*, the *Latitude* continues ſtill the ſame; as *London*, *Briſtol*, *Rocheſter*, *Cardiffe*, *Kingſale*, &c. are all about the ſame *Latitude*.

PROB. IV.

The Day of the Month (or Declination) and Latitude *given, to find the Hour of the Day*, Fig. IV.

1. Find the *Latitude* by the laſt Prob. or by the Tables, and ſlide the Curſor of the *Meridian* to it.

2. Slide the Curſor of the *Axis* to the day of the Month.

3. Turn out the *Æquinoctial*, as far as 'twill go, Fig. III. and gueſſing at the Hour, turn the *Axis* to face that part on the *Æquinoctial*.

4. Hold-

4. Holding the Inſtrument by the little Ring, move it gently to and fro, ſo that the Sun may ſhine through the little hole in the Curſor of the *Axis*, and that Point in the middle Line within-ſide the *Æquinoctial* among the Hours and Parts whereon the Ray or Speek of Light falls, is the true Hour of the Day.

Note, when the *Dial* ſhews the Hour, the *Meridian* of it hangeth directly under that in the Heavens; the Point Fig. III. *N. P.* ſhews the *North Pole*, *S. P.* the *South Pole*, and the *Axis* lyeth according to that of the World; the Points VI. and VI. in the *Æquinoctial* are true *East* and *weſt*; and the middle Line within-ſide is Parallel to the true *Æquinoctial* in the Heavens: The Curſor of the *Meridian* ſhews the *Zenith*, and its oppoſite Point the *Nadir*.

☞ Theſe *Dials*, with a Pedeſtal, ſerve readily to find many other Concluſions, very Pleaſant and Uſeful.

But of this, more in ſome other Treatiſe.

CHAP. X.

A Table of the *Latitudes* of the moſt Eminent Places in *EUROPE* Alphabetically diſpos'd.

Places in *Eng.*	D.	M.	Places in *Eng.*	D.	M.
*A*Bington	51.	42.	*Exeter.*	50.	40.
St. Albans	51.	45.	*Falmouth.*	50.	20.
Apleby	54.	40.	*Gloceſter*	51.	54.
Alesbury	51.	45.	*Guilford.*	51.	11.
Aukland	54.	45.	*Hartford*	51.	49.
Barwick	55.	54.	*Harwich*	52.	05.
Banbury	51.	57.	*Hereford*	51.	08.
Bedford	51.	08.	*Huntington.*	52.	10.
Buckingham	52.	00.	*Ipſwich.*	52.	10.
St. *Edm. Bury*	52.	22.	*St. Ives*	52.	21.
Bridlington	54.	50.	*Kendall*	54.	24.
Briſtol	51.	30.	*Kidderminſter.*	52.	28.
Bath	51.	20.	*Lancaſter*	54.	17.
Boſton.	53.	06.	*Launceſton*	50.	49.
Cambridge	52.	17.	*Leiceſter*	52.	40.
Carliſle	54.	59.	*Leeds*	53.	50.
Canterbury	51.	28.	*Lewis*	50.	46.
Cheſter	53.	17.	*Linn*	53.	52.
Chelmsford	51.	41.	*Lincoln*	53.	15.
Chicheſter	50.	48.	*Litchfield*	52.	45.
Cheſterfield	53.	20.	*Lizard*	50.	10.
Colcheſter	51.	50.	LONDON.	51.	32.
Coventry.	52.	28.	*Mancheſter*	53.	35.
Darby	52.	58.	*Marleborough*	51.	25.
Dartmouth	50.	20.	*Malmsbury.*	51.	35.
Doncaſter	53.	38.	*Nantwich*	53.	08.
Dorcheſter	50.	41.	*New-Caſtle*	55.	02.
Durham	54.	49.	*Newmarket*	52.	18.
Dover.	51.	25.	*Newbury*	51.	25.
Eaton	51.	28.	*Northampton*	52.	14.
Ely	52.	26.	*Nottingham*	52.	59.

Peter-

Places in *Eng.*	D.	M.
Norwich.	52.	42.
Oakham	52.	42.
Oxford.	51.	46.
Peterborough	52.	35.
Plimouth	50.	25.
Portſmouth	50.	45.
Preſton.	53.	55.
Reading	51.	28.
Rocheſter.	51.	24.
Salisbury	51.	03.
Shaftsbury	50.	58.
Shrewsbury	51.	46.
Stanes	51.	30.
Stafford	52.	53.
Stanford	52.	38.
Southampton.	50.	53.
Truero	50.	30.
Tewxbury.	52.	16.
Tunbridge-Wells	51.	05.
Uppingham	52.	38.
Uxbridge.	51.	35.
Ware	51.	48.
Warwick	32.	20.
Weymouth	50.	32.
Wilton	51.	04.
Wincheſter	51.	03.
Windſor	51.	27.
Worceſter	52.	18.
Workenſope.	53.	25.
Yarmouth	52.	44.
York.	53.	58.
Iſle of *Gernſey*	49.	38.
Iſle of *Jerſey*	49.	28
Iſle of *Man*	54.	25.
Iſle of *Portland*	50.	30.
Iſle of *Wight*	50.	49.

Places in *Wales.*	D.	M.
Aberconway	53.	30.
Aberiſtwith	52.	25.
St. Aſaph.	53.	29.
Bala	52.	57.
Bangor	53.	21.
Barmonts	52.	50.
Bealt	52.	10.
Bewmorice	53.	25.
Brecknock.	52.	01.
Cardigan	42.	13.
Carmarthen	51.	55.
Carnarvan	53.	17.
Cardiff	51.	31.
Chepſtow.	51.	42.
St. Davids	51.	59.
Denbigh.	53.	17.
Flint.	53.	21.
Harlech	52.	59.
Holyhead.	53.	33.
Kidwelley	51.	50.
Landaffe.	51.	33.
Montgomery	52.	38.
Monmouth.	51.	54.
Pembrook	51.	46.
Preſtein.	52.	30.
Radnor	52.	23.
Ruthin.	53.	12.
Welchpoole.	52.	44.

Aberdeen

Places in *Scotl.*	D.	M.
Aberdeen	57.	07.
St. Andrews.	56.	25.
Blair	56.	56.
Bas Iſland.	56.	00.
Cromantry.	57.	42.
Dundee	56.	31.
Dunblain	56.	20.
Dunbar	55.	55.
Dunglaſs	55.	55.
Dunfreis	55.	03.
Dunbart	55.	12.
Dunkeld	56.	40.
Dungsby-head	58.	50.
Dunbriton	56.	10.
Dornock.	58.	10.
Edenburg.	56.	06.
Faro-head.	58.	48.
Glaſcow.	55.	58.
Hamiltown	56.	10.
Innerneſs	57.	30.
Irwyn.	55.	50.
Kingſale	57.	44.
Kithneſs.	57.	48.
Larnack.	55.	51.
Montroſs	56.	44.
Mull of Galloway.	54.	48.
Nairn	57.	30.
Orkney Iſle.	58.	50.
Port Patrick	55.	00.
Perth.	56.	30.
Skyraſſin	58.	36.
Sterlin	56.	12.
Withern.	54.	58.

Places in *Ireland.*	D.	M.
ANtrim	54.	45.
Ardmagh	54.	22.
Athlone	53.	20.
Arglaſs.	54.	10.
Bantry	51.	30.
Bellfaſt.	54.	37.
Carlingford	54.	04.
Carickfergus	54.	47.
Caſherlaſh	52.	26.
Charlemount	54.	26.
Clare	52.	44.
Colerain	55.	07.
Cork	51.	46.
Craven.	53.	58.
Dublin	53.	20.
Dunagall	54.	33.
Dungarvon	51.	59.
Dundalk	54.	00.
Droghdagh.	53.	44.
Enniskilling.	54.	17.
Galloway.	53.	10.
James Town.	53.	53.
Kingſaile	51.	32.
Kildare	53.	08.
Kilkenny	52.	35.
Knockfergus	54.	50.
Kings Town.	53.	08.
Liſmore	52.	00.
Longford	53.	42.
London-Derry	54.	57.
Limrick.	52.	32.
Queens Town.	52.	52.
Roſs-common.	53.	36.
Slego.	54.	17.
Waterford	52.	09.
Wexford.	52.	17.

Abbe-

Places in *France.*	D.	M.
Abbeville	50.	09.
Agen	44.	13.
Aix	43.	04.
Alenzon	48.	31.
Ambrun	44.	10.
Amiens	49.	54.
Arles	43.	05.
Aucun	46.	38.
Avignon	43.	22.
Bajonna	43.	38.
Beſancon	47.	07.
Blois	47.	34.
Boulogne	50.	47.
Bourdeaux	44.	50.
Bourges	46.	55.
Caen	49.	19.
Calais	51.	02.
Caudebeck	49.	37.
Chartres	46.	20.
Clermont	45.	28.
Deippe	49.	59.
Dunkirk	51.	07.
Grenoble	44.	54.
Langres	47.	44.
Lyons	45.	24.
Marſelles	42.	47.
Metz	49.	15.
Mompelier	43.	08.
Nantes	47.	13.
Orlcans	47.	44.
Paris	48.	45.
Pigneroll	44.	26.
Poictiers	46.	34.
Rodes	44.	17.
Roven	49.	26.
Toulouſe	43.	29.

Places in *Germ.*	D.	M.
Aix le Chapelle	50.	28.
Ausburg	48.	14.
Baden	48.	38.
Bamberg	49.	53.
Bintzen	51.	13.
Berlin	52.	33.
Brandenburg	52.	34.
Breme	53.	22.
Breſſaw	51.	04.
Brunſwick	52.	36.
Carolſtad	45.	50.
Caſſell	51.	20.
Coblentz	50.	22.
Conſtace	47.	27.
Dreſden	51.	06.
Emden	53.	47.
Erfurd	51.	01.
Ferden	53.	14.
Francfort	50.	03.
Hannaw	50.	03.
Hannover	52.	35.
Heidleburg	49.	17.
Lunenburg	53.	42.
Magdeburg	47.	58.
Munchen	47.	58.
Nurenburg	49.	24.
St. Omers	50.	52.
Prague	49.	58.
Ratisbone	48.	55.
Roſtock	54.	22.
Santen	51.	38.
Schwartzenberg	49.	37.
Strasburg	48.	28.
Vienna	48.	14.
Wittenburg	51.	54.

Alicaut

Places in *Spain.*	D.	M.
Alicaut	33.	25.
Badajos	38.	45.
Barcelona	40.	34.
Bilbo	43.	47.
Burgos	42.	25.
Cadiz	36.	32.
Compoſtella	43.	00.
Corduba	37.	39.
Deva	43.	34.
Gibralter	35.	54.
Granada	37.	28.
Jaen	37.	50.
Leon	42.	44.
St. Luca	37.	33.
Majorca	39.	04.
Malaga	36.	40.
Medina-celi	41.	12.
Milan	44.	55.
Origuella	38.	08.
Orenſe	42.	30.
Olite	42.	28.
Oviedo	43.	23.
Placentia	39.	48.
Ronda	36.	25.
Salamanca	41.	14.
Santillana	43.	30.
Saragoſa	41.	35.
Segovia	40.	56.
Seville	37.	30.
Tarragon	40.	36.
Toledo	39.	24.
Tudela	42.	05.

Places in *Italy.*	D.	M.
Aucona	43.	26.
Aquila	42.	18.
Bari	41.	07.
Benevento	41.	12.
Bergamo	45.	16.
Bologua	44.	08.
Breſcia	45.	08.
Capona	41.	14.
Caſale	44.	40.
Catana	36.	55.
Chambrey	45.	40.
Coſenze	39.	14.
Cremona	44.	42.
Ferrara	44.	34.
Florence	43.	20.
Forli	43.	56.
Geneva	46.	04.
Genoa	42.	53.
Leghorn	42.	52.
Loretto	43.	12.
Letterre	40.	47.
Lucca	43.	13.
Mantua	44.	52.
Meſſina	37.	54.
Modena	44.	14.
Naples	40.	56.
Oria	40.	35.
Oppido	38.	07.
Orbitello	42.	43.
Piſa	43.	04.
Parma	44.	24.
Pavia	44.	38.
Radua	45.	17.
Rome	41.	50.
Turin	44.	34.
Venice	45.	20.

Am-

Places in the *Low-Countries.*	D.	M.
Amſterdam	52.	29.
Antwerp	51.	16.
Arras	50.	20.
Boisledue	51.	42.
Breda	51.	38.
Bruges	51.	17.
Bruſſels	51.	54.
Culenburg	51.	58.
Cambra	50.	55.
Dam	51.	17.
Dalem	50.	45.
Delft	52.	05.
Dendermond	51.	06.
Deventer	52.	24.
Dieſt	51.	03.
Dinant	50.	12.
Dixmude	51.	06.
Ghent.	51.	06.
Haerlem	52.	31.
Hague.	52.	08.
Leyden	52.	13.
Liege	40.	42.
Leſſines	50.	50.
Loveſtin	51.	50.
Luxenburg.	49.	41.
Maeſtricht	50.	54.
Mechlin	51.	06.
Midleburg	51.	35.
Mons.	50.	28.
Namur.	50.	32.
Nimmegen.	51.	52.
Oſtend.	51.	18.
Rotterdam.	52.	00.
Uſtrcht.	52.	09.

Turkey.	D.	M.
Adrianople.	43.	18.
Bagnialuck	44.	28.
Belgrade.	44.	20.
Conſtantinople.	43.	00.
Croia	43.	25.
Larriſſa	39.	45.
Leopanto.	37.	25.
Meſember	44.	36.
Negropont.	38.	20.
Preveſa	38.	24.
Priſtina	43.	15.
Seliveca	42.	56.
Semendria	45.	12.
Sofia	43.	25.

Ruſſia.	D.	M.
Arch-Angel	64.	50.
Czernihow	51.	48.
Moſcow	55.	25.
Novogrod	58.	10.
Smolensko	54.	31.
Suſdall	56.	35.
Worrotin	54.	10.

Swedeland.	D.	M.
Abo	60.	20.
Baſill	47.	34.
Bern	46.	45.
Calmar	57.	06.
Gothbourg	58.	02.
Luden	56.	44.
Phillipſtat	59.	50.
Stockholm	59.	26.
Wisby	51.	50.
Wolmer	57.	23.
Zurick	47.	12.

A Table

A *Table* of *Equation*, shewing the *Difference* of a well Adjust'ned *Pendulum* and the *Sun*, every Day in the Year.

Days	*Januar.*		*Februa.*		*March*		*April*		*May*		*June*	
	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.
1	8	53	14	49	10	12	0	53	4	9	1	8
2	9	15	14	47	9	54	0	36	4	10	0	56
3	9	37	14	45	9	38	0	20	4	12	0	43
4	9	59	14	42	9	21	0	4	4	13	0	31
5	10	20	14	39	9	4	0	*11	4	12	0	19
6	10	41	14	34	8	46	0	26	4	12	0	6
7	11	0	14	29	8	28	0	41	4	11	0	*7
8	11	18	14	24	8	10	0	55	4	9	0	20
9	11	36	14	18	7	52	1	9	4	7	0	33
10	11	54	14	11	7	34	1	22	4	4	0	46
11	12	10	14	3	7	15	1	35	4	0	0	58
12	12	26	13	54	6	56	1	48	3	58	1	11
13	12	41	13	45	6	38	2	0	3	53	1	24
14	12	55	13	36	6	19	2	11	3	48	1	37
15	13	9	13	26	6	0	2	22	3	43	1	50
16	13	21	13	15	5	41	2	33	3	34	2	2
17	13	33	13	4	5	23	2	43	3	31	2	14
18	13	43	12	53	5	4	2	52	3	24	2	26
19	13	53	12	41	4	45	3	1	3	17	2	38
20	14	3	12	28	4	26	3	10	3	9	2	50
21	14	11	12	15	4	7	3	18	3	0	3	2
22	14	18	12	1	3	49	3	26	2	52	3	13
23	14	25	11	47	3	31	3	33	2	43	3	25
24	14	31	11	32	3	13	3	40	2	34	3	36
25	14	36	11	16	3	54	3	46	2	24	3	46
26	14	40	11	1	2	35	3	51	2	14	3	57
27	14	43	10	46	2	17	3	55	2	4	4	7
28	14	46	10	30	2	0	3	59	1	53	4	*16
29	14	47			1	42	4	3	1	42	4	25
30	14	48			1	25	4	6	1	31	4	33
31	14	49			1	9			1	19		

Pendulum Gains — Gains — Gains — Looses — Looses — Looses — Looses — Looses — Gains — Gains — Gains — Gains

Days	July		August		Septemb.		October		Novem.		Decemb.	
	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.	M.	S.
1	4	41	4	32	3	43	13	11	15	25	5	49
2	4	49	4	23	4	4	13	25	15	17	5	20
3	4	57	4	13	4	24	13	39	15	8	4	52
4	5	4	4	2	4	45	13	53	14	58	4	23
5	5	10	4	51	5	5	14	5	14	47	3	54
6	5	13	3	40	5	26	14	17	14	35	3	25
7	5	22	3	27	5	46	14	28	14	23	2	55
8	5	27	3	14	6	7	14	39	14	10	2	25
9	5	31	3	1	6	28	14	49	13	56	1	55
10	5	35	2	48	6	48	14	59	13	41	1	25
11	5	38	2	34	7	9	15	9	13	25	0	56
12	5	41	2	20	7	29	15	18	13	8	0	26
13	5	43	2	5	7	49	15	25	12	51	0	*4
14	5	45	1	50	8	09	15	31	12	33	0	34
15	5	46	1	34	8	29	15	37	12	14	1	4
16	5	46	1	17	8	48	15	43	11	55	1	34
17	5	45	1	00	9	8	15	47	11	35	2	4
18	5	44	0	43	9	28	15	52	11	14	2	33
19	5	43	0	26	9	47	15	55	10	53	3	2
20	5	41	0	9	10	7	15	57	10	31	3	31
21	5	39	0	*9	10	25	15	59	10	8	4	00
22	5	36	0	27	10	43	16	00	9	44	4	26
23	5	32	0	46	11	1	16	00	9	20	4	56
24	5	28	1	5	11	19	15	59	8	55	5	23
25	5	23	1	24	11	37	15	58	8	30	5	50
26	5	17	1	44	11	54	15	56	8	4	6	17
27	5	11	2	3	12	10	15	53	7	38	6	44
28	5	5	2	22	12	26	15	49	7	12	7	10
29	4	58	2	24	12	41	15	44	6	45	7	36
30	4	50	3	3	12	57	15	38	6	17	8	00
31	4	41	3	27			15	32			8	24

Gains / Looses

☞ Note this Asterick * shews where the Alteration begins.

FINIS.


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